CHANNEL WAVEGUIDE RADIATOR

BY

FU HSINE YANG

B.S., National Wu-han University, 1942
M.S., University of Illinois, 1948

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CHANNEL WAVEGUIDE RADIATOR

A channel waveguide radiator consists of a waveguide having a long axial slot milled on its narrow side wall. In this thesis, two important new types of channel waveguide radiator are investigated. They are (1) a rectangular channel waveguide mounted inside an axially slotted conducting cylinder having its slot coincident with the mouth of the channel, and (2) two axially slotted circular waveguides with one mounted inside the other such that the slots are coincident.

An answer of considerable importance which is obtained in this study is the longitudinal phase and attenuation constants of the channel waveguide radiator. The solution to the problem is obtained by solving Maxwell's equation subject to the boundary conditions imposed on the system.

The phase constant is determined by considering the edges of the slot as constituting a loaded parallel-wire transmission line and it is shown that the cut-off wavelength of the dominant wave in an axially-slotted perfectly conducting, infinitely long hollow cylinder of arbitrary cross-section occurs at the first zero of the total distributed slot susceptance. The latter is the sum of the susceptances looking at the slot toward the inside and the outside regions of the channel. The general expressions of these susceptances as well as a set of graphical representations of their numerical values are given for the axially slotted circular cylinders. The cut-off wavelength for each of the two types of channel waveguide radiator is then determined by a graphical method. It is shown that with the calculated cut-off wavelength, the guided wavelength may be obtained by a successive approximation method. Excellent agreement is obtained between theoretical and experimental values of the longitudinal phase constant.

The method for obtaining the longitudinal attenuation constant of the channel waveguide radiator is to first compute the total power radiated by the system. It is done by integrating the Poynting vector of the distant fields. The magnetic dipole approach is used to find the radiation fields. That is, the slotted cylinder is considered as a magnetic dipole adjacent to the cylinder. The method is of interest because the resultant expression for the power radiated from a traveling-wave-excited finite slot in a long cylinder is in such a form as to be amenable to numerical computation without too great difficulty. The calculated and the experimental values of the longitudinal attenuation constant agree fairly well.

VITA

Fu Hsine Yang was born on November 5, 1917 in Nanking, China. After graduating from Lu-chow Middle School, Anhwei, China, he entered National Wu-han University, Wuchaung, China and received the degree of Bachelor of Science in physics from that institution in June, 1942. He became a research assistant at the Radio Research Institute, National Tsing-hua University, Kunming, China from July, 1942 to March, 1945. He came to the U.S.A. in May, 1945 and was employed by Washington Institute of Technology, Inc., Washington, D. C. as a junior engineer until August, 1946. From September, 1946 to June, 1947, he was employed by the Radiosonde Laboratory, Department of Meteorology, University of Chicago as a research assistant. He entered the Graduate College of the University of Illinois in July, 1947 and held a research assistantship in the Department of Electrical Engineering, University of Illinois until August, 1950. He received the degree of Master of Science in electrical engineering from this institution in June, 1948. Since September, 1950, he has been Assistant Professor in Electrical Engineering at South Dakota State College.